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THERMAL PROPERTIES OF STEAM

The great amount of power generated by steam makes an accurate knowledge of its thermal properties of economic importance. The tables of these properties used by engineers all over the world should be uniform.

The Bureau has recently completed a determination of the properties of saturated water and steam in the range 0° to 374° C (32° to 705° F), that is, between the normal freezing point and the critical region, where the pressure is about 3,200 lb/in^2. These measurements were made in several stages, each stage covering a particular temperature interval. The work was sponsored by the American Society of Mechanical Engineers and was part of a cooperative research shared by several other institutions here and abroad. In a recent publication these saturation data were assembled into a thermodynamically consistent group of tables with experimental irregularities smoothed out by use of empirical formulas. This compilation is in a form suitable for enlargement and inclusion in a complete steam table. Indeed, the results have already been made available for use in the steam tables which have been recently published in America, Great Britain, and Germany. As a result of the international cooperation these tables are now in good accord.

The range from 0° to 100° C (32° to 212° F) is of particular importance. In calorimetric work the heat capacity of liquid water is used as a standard for measuring the heat capacity of other substances, for example, the enthalpy of superheated steam. In the past it has also been used to specify and define certain heat units known as calories or as British thermal units, and the "mechanical equivalent of heat" is a term used to designate the equivalents of these heat units in the ordinary units of mechanical energy, that is, foot pounds or watt-seconds.

Although in the past much effort has been spent in the measurement of the heat capacity of water, there remained considerable uncertainty in the values

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because of the discordance between results of the different observers.

To provide greater certainty in the values of the specific heat of water for calorimetric purposes, and to provide greater reliability in the values of enthalpy and the other derived properties for use in steam tables, new measurements of the heat capacity and heat of vaporization of water in the range 0° to 100° C (32° to 212° F) have now been made. New calorimetric equipment was built which was specially designed for accurate work in this range.

Another recent publication of the Bureau describes this new equipment and gives the results obtained with it. A comparative review is given of previous results in this range. The corroboration of earlier work is for the most part satisfactory, whereas the greater detail of the present work adds to the reliability and usefulness of the revised tables of data now given.

PRECISION OF KNOCK RATING, 1936–38

In 1936 the Bureau reported an analysis of 2,180 cooperative knock ratings on 99 fuels. Recently the Bureau was asked by the Cooperative Fuel Research Committee to analyze data which had accumulated since the earlier analysis. These data comprised 6,386 tests by over 100 laboratories on 136 fuels.

After examining the data, D. B. Brooks and R. B. Cleaton find that of the 2,493 tests made by the cooperative exchange laboratories in accordance with the ASTM method, 92.5 percent of the results deviate from the respective mean values by less than one octane unit as compared with 86.9 percent in the 1936 analysis. The precision of rating average fuel is now 0.52 octane unit, as compared with the value 0.63 found in the earlier analysis. The maximum precision attainable with present apparatus is estimated to be 0.36 octane unit; support of this estimate is found in the fact that 207 tests by the best 2 laboratories show a precision of 0.40 octane unit.

The value of periodic cooperative knock ratings in improving precision is demonstrated by the results of the past six sets of semiannual cooperative tests, in which nonmember participants show 40 percent larger error than exchange group laboratories which participate in monthly cooperative tests.

No improvement has been manifested in the past 3 years in the rating of fuels of over 80 octane number. An improvement is noticeable in the case of cracked fuels, although the error of rating them is still one-third larger than for straight-run gasolines.

Precision of rating by the 1939 CFR research method is close to that for the ASTM method, whereas the 1932 CFR research method shows two-thirds larger error than the revised version. The current L–3 method is but slightly inferior to the ASTM method.

The results of the 1936 analysis on the effect of atmospheric and engine variables are verified. More attention should be given to obtaining standard intensity of knock, the limit on hours between engine overhaul should be observed, and humidity should be controlled if precision is to be improved.

ERRORS OF WET TEST GAS METERS

Gas volumes and rates of gas flow are often measured in a laboratory by means of a wet test meter, with water as the confining liquid. In passing through such a meter, gas takes up water vapor. When completely saturated at a given temperature, the proportion of water vapor to gas is well known. If it is assumed that the gas is completely saturated in passing through such a meter, the volume of dry gas passed through can be easily and accurately calculated. If, however, the gas does not become completely saturated, the calculation of the volume of dry gas will be in error.

The volume of gas passing through a wet test meter for each revolution of the meter drum depends on the volume of water in the meter. This volume is carefully adjusted during calibration, with the meter accurately leveled, and the level of the water is marked on a gage. During subsequent use, any failure to level the meter before adjusting the water level to this mark, or failure to have the same volume of water in the meter as at calibration, will cause an error in the indication of the total volume of gas and water vapor.

At the request of the subcommittee of the American Society for Testing Materials, which deals with measurement of samples of gaseous fuels, F. A. Smith and J. A. Eiseman, of the Bureau's gas chemistry section, undertook to determine how nearly the gas passing through a laboratory wet test meter (at the usual rates of flow) becomes saturated with water, and the magnitude of the error in indication resulting from any lack of saturation. A deter-

mination was also made of the error in the indicated volume resulting from a failure to level the meter before use.

The tests, which are reported in RP1238 in the September Journal of Research, indicated that dry air became over 98 percent saturated on passing through the meter, at all practicable rates of flow. The error in the indicated volume, caused by the lack of complete saturation, was found by direct determination to be less than 0.2 percent. It was also found that a relatively large and easily noticeable departure of the meter from level introduced no error larger than 0.1 percent in the indicated volume as long as the correct volume of water, determined by calibration, was maintained in the meter. On the other hand, after the proper water level had been determined by calibration and its position marked in the gage, setting the water level to the mark when the meter was not accurately leveled altered the correct volume of water and introduced an error of the order of 1 percent.

In general, the tests showed that errors in the indication of small laboratory wet-test meters arising from incomplete saturation of the gas, or from inaccurate leveling, are small.

EFFECTS OF HUMIDITY AND COMPOSITION ON ENAMELS

Vitreous (porcelain) enamels are harder to break in dry weather than in damp weather, according to the results of a study recently completed by D. G. Moore and W. N. Harrison, of the Bureau's enameled metals section, and reported in detail in the Journal of Research for September (RP1237). Twenty-gage angle irons, 8 in. long, made by bending 8- by 2-in. strips of enameling-grade sheet iron, were enameled and tested by twisting until the enamel chipped at the apex. The angle of twist required to cause failure was taken as the index of resistance to chipping in torsion. For an enamel thickness of 0.015 inch, a decrease in relative humidity from 98 to 35 percent caused a 15-percent increase in the angle of twist required to produce chipping. The temperature was constant. Specimens given a thin coating of paraffin after firing, and before they had completely cooled, were tested at 98-percent relative humidity and withstood nearly a 30-percent greater angle of twist without failure than uncoated specimens tested under the same conditions.

Also, modulus of rupture was determined on fibers of enamel frit about 0.75 mm thick. In a period of relatively high humidity, fibers of one frit showed a failure of 10 specimens out of 20 at the end of a 20-hour sustained-load test in which the stress was 9 kg/mm^2. Later, under the same conditions, except for lower humidity, this frit showed a failure of only 3 out of 20 specimens after the usual 20-hour sustained-load test. However, when a small drop of water was placed gently over the midpoint of each specimen, the remaining test fibers began breaking almost immediately and 10 additional specimens had broken within 40 minutes, raising the percentage of failure from 15 to 65. Calculations indicated that the weight of the drops of water could not have increased the maximum fiber stress by more than 0.03 kg/mm^2.

Under controlled atmospheric conditions, the modulus of rupture of relatively fusible ground-coat enamel fibers increased from 4.7 to 7.2 kg/mm^2, or more than 50 percent, when the humidity was decreased from 90 to 56 percent in sustained-load tests. Under the same conditions, the strength of acid-resisting enamel-frit fibers increased from 8.4 to 9.7 kg/mm^2, or 15 percent.

When dried over $CaCl_2$ and tested under kerosene for modulus of rupture with increasing load, the ground-coat frit was 30 percent stronger than when stored in the open air and tested under water. The acid-resisting frit was 50 percent stronger.

Previous reports of other investigators have shown that such properties as the resistance of whiteware glazes to abrasion by falling sand, the transverse strength of glass bars loaded at placed scratches, and the tensile strength of fused-quartz filaments a few microns in diameter are also affected by large changes in atmospheric humidity.

It is evident that in future testing of the physical properties of materials, such as vitreous enamels, glasses, and ceramic glazes, atmospheric humidity should be taken into account in order to obtain consistent results.

MEASURING THICKNESS OF ZINC AND CADMIUM COATINGS ON STEEL

One of the present trends in the electroplating industry is toward the use of specifications requiring a certain minimum thickness of coating. At the present time a few samples out of a shipment are tested by an accurate method. However, more information about the shipment could be obtained

by testing a larger number of samples by a more rapid, though perhaps less accurate, method.

The Hull-Strausser dropping test has been extensively used as a rapid method for measuring the thickness of zinc and cadmium coatings. Because of reported difficulties with the end point, Abner Brenner, of the Bureau's electrochemistry section, recently investigated the method and was able to make some improvements in the apparatus. For comparison, thickness tests were also made by the jet, magnetic, and microscopic methods.

As explained in the September Journal of Research (RP1240), the ammonium nitrate dropping-test reagents, which are now in use, did not give satisfactory end points with zinc-mercury coatings and did not dissolve different types of bright cadmium coatings at the same rate. A new reagent containing 200 g/liter of chromic acid and 50 g/liter of sulphuric acid overcame these difficulties and had the additional advantage that only one reagent was required for testing different types of zinc and cadmium coatings. On commercial specimens this reagent gave an average error of ±12 percent and maximum errors of about ±20 percent. The jet method and the microscopic method are not very satisfactory for measuring the thickness of zinc and cadmium coatings, although the latter is now the umpire method. The magnetic method usually yields errors less than ±15 percent and appears promising. Its chief limitation is that it cannot satisfactorily measure thin coatings on rough basis metals.

Mr. Brenner suggests that the dropping test, with the chromic acid reagent, be used for the acceptance testing of zinc and cadmium deposits. A tolerance of 20 percent should be given, to allow for the errors of the method.

REMOVAL OF SOIL-CORROSION SPECIMENS

Beginning early in September, specimens of ferrous and nonferrous pipe and of certain protective materials which have been buried in the ground for various periods of from 2 to 17 years will be removed for inspection.

A few additional materials will also be buried for further test. K. H. Logan, in charge of the Bureau's soil corrosion section, will supervise the work and will be glad to hear from those who may desire to witness the removal of specimens in their vicinity. Letters should be addressed to Soil Corrosion Section, National Bureau of Standards, Washington, D. C.

The following materials were buried in 1922: Armco iron, wrought iron, Bessemer steel, open-hearth steel, copper bearing steel, Duriron, fiber, De-Lavaud cast iron, pit cast iron, and lead.

The following materials were buried in 1924: lead-coated pipe; three kinds of galvanized pipe and sheet; three kinds of bitumen-coated pipe; brass attached to lead, brass, or galvanized iron.

Two materials were buried in 1926: copper pipe and brass pipe.

The above-named materials will be removed in accordance with the following schedule, thus completing the tests at the sites named:

Test site near	Cooperating utility	Official to see for information	Tentative date for removal of specimens
Alexandria, Va	Water Dept	Supt	Sept. 5.
Boston, Mass	Gas Co	Supt	Sept. 14.
Bunkie, La	Standard Oil Co. of La	Supt	Nov. 13.
Camden, N. J	Water Dept	Engineer	Sept. 8.
Cincinnati, Ohio	Gas & Electric Co	Supt. of dist	Sept. 22.
Dallas, Tex	Gas Co	Supt. of dist	Oct. 31.
Davenport, Iowa	United Light & Power Eng. & Const. Co.	O. K. Smith, Chem. Eng.	Sept. 28.
Jacksonville, Fla	City commission	Supt. Water Dept	Nov. 17.
Kansas City, Mo	Gas Co	C. H. Waring	Sept. 29.
Los Angeles, Calif	Southern Calif. Gas Co	W. M. Henderson	Oct. 12 & 13.
Meridian, Miss	Water Dept	Supt	Nov. 7.
Middleboro, Mass	City	Town manager	Sept. 15.
Milwaukee, Wis	Water Dept	Supt	Sept. 27.
Oakland, Calif	East Bay Municipal Utility Dist	Chief engineer	Oct. 6.
Piqua, Ohio	Tidewater Pipe Co	J. Z. VanTine	Sept. 19.
Salt Lake City, Utah	Mountain Fuel Supply Co	Manager	Oct. 2.
San Antonio, Tex	Public Service Co	Supt. Gas Dept	Oct. 23.
Seattle, Wash	Dept. Public Works	T. H. Carver	Oct. 4.
Springfield, Ohio	Water Dept	Supt	Sept. 20.

The following materials will be removed from the sites named in the next table: Armco iron, wrought iron, Bessemer steel, Monocast iron, pit cast iron. This will complete the tests at these sites.

Test site near	Cooperating utility	Official to see for information	Tentative date for removal of specimens
Atlanta, Ga	Southern Cities Public Service	E. C. Kollock, mgr	Nov. 28
Charlotte, N. C	Southern Public Utilities	Manager	Nov. 29
Cincinnati, Ohio	Union G. & E. Co	Supt. of Gas Dist	Sept. 2
Houston, Tex	Humble Oil Pipe Line Co	R. A. Brannon	Oct. 24
Macon, Ga	Gas Co	Manager	Nov. 22
Pensacola, Fla	Florida Public Utilities	Manager	Nov. 16
Phoenix, Ariz	Water Dept	Engineer	Oct. 20
Raleigh, N. C	Gas Co	Manager	Dec. 4
Salisbury, N. C	Southern Public Utilities	Engineer	Oct. 20
Shreveport, La	Southern Cities Distributing Co	Burt Smith	Nov. 1
Tampa, Fla	Gas Co	Manager	Nov. 20
Vicksburg, Miss	Gas Co	Manager	Nov. 3

From the sites listed in the following table will be removed so-called corrosion-resistant materials buried in 1932 and 1937. These include some of the commonly used pipe materials as well as a large variety of ferrous and nonferrous alloys. About 15 kinds of nonbituminous pipe coatings will also be inspected. There are about 75 varieties of materials at these test sites. About 10 additional materials will be buried.

Test site near	Cooperating utility	Official to see for information	Tentative date for removal of specimens
Atlanta, Ga	Water Dept	W. M. Rapp	Nov. 23
Baltimore, Md	Water Dept	Leon Small	Sept. 7
Beaumont, Tex	Gulf Pipe Line Co., Houston	Walter Rogers	Oct. 25
Button Willow, Calif	San Joaquin Light & Power Co., Bakersfield.	A. Y. Meudell	Oct. 11
Charleston, S. C	Water Dept	J. E. Gibson	Nov. 24
Kalamazoo, Mich	Dept. of Public Utilities	E. E. Norman	Sept. 25
Los Angeles, Calif	Shell Oil Co., Wilmington, Calif	I. M. Hemphill	Oct. 16
Meridian, Miss	Water Dept	J. T. Pinkston	Nov. 6
Milwaukee, Wis	Gas Co	W. E. Kemmen	Sept. 26
New Orleans, La	Public Service Co	G. L. Rhodes	Nov. 9
Paso Robles, Calif	Union Oil Co., San Luis Obispo	Lafe Todd	Oct. 9
Phoenix, Ariz	Water Dept	City engineer	Oct. 19
Plymouth, Ohio	Ohio Fuel Gas Co	H. S. Riddle	Sept. 18

CHANGES ACCOMPANYING CONVERSION OF REFRACTORY CLAYS INTO FIREBRICK

In converting raw refractory clays into finished firebrick, numerous physical and mineralogical changes occur. It is important to know what these changes are and at what temperatures they occur if the desired properties in a fired brick are to be properly developed.

R. A. Heindl and L. E. Mong, of the Bureau's section on refractories, have just completed a study of two of the changes which occur with the heating of raw clays, namely, changes in length (expansion and contraction) and endothermic and exothermic effects. Changes of these types occurring between room temperature and 1,000°C were observed in specimens of flint clays from Kentucky, Missouri, Ohio, Pennsylvania, and Washington; and in a plastic clay from Pennsylvania, a hard kaolin and bauxitic clay from Georgia, a Zettlitz kaolin, and a diaspore from Missouri. These materials were tested in granular and in pulverized condition, both in air and in an atmosphere of the products of gas combustion.

It was found that all the flint clays (except one mined in Pennsylvania) and the Georgia and Zettlitz kaolins

showed a slight expansion between room temperature and approximately 500°C, a rapid contraction of considerable proportions between approximately 500° and 600°C, a gradual contraction between about 600° and 925°C, a rapid contraction between approximately 925° and 980°C, and a slower contraction again from there to 1,000°C. The clay which was the exception, in the granular condition, showed a sharp expansion between about 540° and 590°C; but when pulverized to pass a No. 200 sieve, its behavior was similar to that of the other flint clays.

The clays when pulverized showed greater total shrinkage up to 1,000°C than when in granular pieces.

The clays, in general, contracted slightly more in an atmosphere of the products of gas combustion than in air. Also, the rapid contraction occurred at slightly lower temperatures for the fine than for the coarse material, except in the case of the Missouri flint clay in which no difference was shown.

Endothermic reactions took place during heating between approximately 475° and 575°C, and exothermic reactions between about 940° and 990°C, in all the flint clays, the plastic clay, and the Georgia kaolin. These temperature ranges corresponded fairly closely to those in which rapid contraction took place. The bauxitic Georgia kaolin showed an endothermic effect between 250° and 310°C, in addition to the two effects which occurred within the same temperature ranges as those in the other clays. Diaspore showed but one heat effect and one zone of contraction, namely, between 450° and 510°C.

The complete report of this work will be found in the Journal of Research for September (RP1243).

APPARATUS FOR MAGNETIC TESTING

The magnetic testing of the new types of permanent magnet material, of which the alloy called Alnico is probably the best known, requires higher magnetizing forces than are needed in the testing of the older types of material. In order to meet this requirement a new permeameter has recently been developed by R. L. Sanford and E. G. Bennett, of the Bureau's magnetic measurements section. This instrument, which is described in detail in the Journal of Research for September (RP1242), is capable of testing at magnetizing forces up to 5,000 oersteds, which is ample for the hardest materials in present use.

In the design of this instrument the aim was to obtain a high degree of accuracy, together with simplicity and convenience in operation. Under ordinary conditions values obtained of either magnetizing force or magnetic induction are estimated to be accurate within 1 percent. Specimens having rectangular cross sections up to ¾ by 1½ inches can be tested, and experiments have shown that satisfactory results can be obtained with specimens as short as 1 inch.

METHOD OF DESIGNATING COLORS

In 1931 the first chairman of the Inter-Society Color Council, E. N. Gathercoal, proposed on behalf of the U. S. Pharmacopoeial Revision Committee the problem of devising a system of color designations for drugs and chemicals. He said: "A means of designating colors in the United States Pharmacopoeia, in the National Formulary, and in general pharmaceutical literature is desired; such designation to be sufficiently standardized as to be acceptable and usable by science, art, and industry, and sufficiently commonplace to be understood, at least in a general way, by the whole public." With the assistance of the American Pharmaceutical Association and following plans outlined in 1933 by the Inter-Society Color Council, D. B. Judd, of the Bureau's Colorimetry Section, and K. L. Kelly, research associate of the American Pharmaceutical Association, have worked out a solution for this problem which substantially fulfills the requirements laid down by Dr. Gathercoal. The system is described in RP1239 in the September Journal of Research.

AIRPLANE DOPES

The third in a series of reports on an investigation of the formulation of airplane dopes has just been released. In the first report it was stated that the most important single factor involved in the initial tautening property of a dope is the solvent composition. The second report presented the results of an investigation of the effect of the four variables, namely, plastic, plasticizer, solvent, and diluent, on the shrinkage and flexibility of films formed from solutions. Experimental dope formulas were developed on the basis of these data. This third report by F. W. Rein-

hart and G. M. Kline, of the Bureau's Organic Plastics Section, describes exposure tests made upon these experimental dopes and discusses the correlation between the tautening and weathering qualities of the dopes and their composition.

Cellulose acetopropionate and cellulose acetobutyrate were found to be the most promising film-forming bases for a relatively nonflammable airplane dope to replace the hazardous cellulose nitrate. The hydroxyl content of these mixed esters is an important factor in their suitability for this purpose; the hydroxyl content recommended as a result of this work is about 0.2 equivalent. Optimum solvent formulas are listed for various cellulose derivatives; these produced marked improvement in the tautness and aging of the dopes when compared with those used in the original group of exposure panels described in the first report. The tautness of some dopes formulated with cellulose-mixed esters and aryl phosphate plasticizers compared favorably with that of cellulose nitrate dope plasticized with glycol sebacate. The similarity in electronic structure of the phosphate and nitrate groups is advanced as a possible explanation of this correlation in the behavior of these two types of dopes.

A close relationship was shown to exist between film properties and the behavior of doped fabrics. The use of the film technic in place of the application of each experimental dope to fabric-covered panels permits a considerable saving in time, labor, and materials in evaluating new compounds and formulas.

The effect of the application of various flameproofing agents to the cloth on the tautening and weathering qualities of the cellulose acetopropionate and cellulose acetobutyrate dopes which have given the best results in the tests to date is now being investigated.

TESTS FOR QUALITY IN TEXTILES

"Physical Tests for Quality in Textiles" will be the subject of an address by Herbert F. Schiefer, of the Bureau's textile section, before the cellulose Division of the American Chemical Society, which meets in Boston on September 11 to 15.

Mr. Schiefer will discuss the factors which affect the quality of textiles and will then take up in detail the various tests for breaking strength. Special consideration is to be given to a statistical analysis of results obtained with different rates of loading and two types of machines.

The foundations of strength in cotton fiber and in cotton yarn will be described, and the analogous effects of twist in the two will be indicated.

At the Bureau, many tests for textiles have been developed which simulate closely conditions of actual use, an example being the hosiery-testing machine designed by Mr. Schiefer. Typical tests of this kind, on the basis of which the proper performance of textiles in service can be predicted, will be described as the concluding part of the paper.

COMPARISON OF ACCELERATED AND NORMAL AGING OF RECORD PAPERS

Retests at the Bureau of record papers that had been stored under normal conditions for 8 years give additional evidence of the good correlation between the effects of natural aging of such papers and accelerated aging by heating for 72 hours at 100°C.

The findings agree well with those obtained by a retest made 4 years ago. The retention of folding endurance of the papers under normal aging was of the same relative order as under accelerated aging. Furthermore, the same relation of chemical properties to the retention of folding endurance was found for both kinds of aging. The more stable papers were characterized by a good condition of cellulose and by low or moderate acidity. Under both aging conditions the cellulose of the better papers exhibited little change, but the inferior cellulose of the unstable papers became considerably more degraded, which indicated a breaking down of the fiber structure with consequent loss of strength. The Bureau recently tested some papers from old books that had been stored for 150 to 200 years. The papers had deteriorated greatly, apparently because of adverse storage conditions. They had lost practically all of their strength, and they showed the same kind of degradation of cellulose, to an exaggerated degree, as that found in the unstable papers stored at the Bureau.

These and many other of the Bureau's studies show that accelerated aging by heating is a useful guide in the grading of papers for stability. That such a guide is needed is illustrated by the wide spread in stability of the stored papers even in such a short period as 8 years; the best papers retained as much as 90 percent of their original folding endurance while some

of the poorest retained as little as 15 percent.

A complete account of this work is given in a paper (RP1241) by B. W. Scribner in the September number of the Journal of Research.

OPTICAL DISPERSION OF RUBBER

In J. Research NBS, 14, 553 (RP786) values were given for the refractive index of rubber at three different wave lengths. The dispersion was found from the difference between the indices for the *F* and the *C* lines of the hydrogen spectrum, as measured with a Pulfrich refractometer. It has recently been discovered that on account of a clerical error incorrect values were given for the refractive index of the *F* line and for the dispersion. The corrected results are as follows:

Spectrum line	Refractive index at temperature of	
	24.5° C	25.0° C
n_F	1.5283	1.5281
n_D	1.5190	1.5188
n_C	1.5153	1.5151
$n_F - n_C$	0.0130	0.0130

Additional measurements have been made by several different methods. The most reliable measurements were made by means of a spectrometer using rubber prisms made by molding the rubber between two plane parallel glass plates inclined at the desired angle. Data for pale crepe are as follows:

Spectrum line	Refractive index at 25° C
n_F	1.52841
n_D	1.51899
n_C	1.51527
$n_F - n_C$	0.01314

A paper on this subject is in preparation.

SECOND SPECTRUM OF CHLORINE

A paper by C. C. Kiess and T. L. deBruin, published as RP1244 in the September Journal of Research, gives a new description of the spectrum emitted by singly ionized chlorine atoms, including a list of wave lengths, with their classifications, extending from 9483 A, in the infrared, to 558 A in the Schumann region. The classifications are based on the quintet, triplet, and singlet terms that are theoretically required for the chlorine ion. The deepest term has a value of 192,000 cm^{-1}, from which an ionization potential of 23.70 volts is derived.

PROPOSED CALENDAR REFORM

In a paper by H. W. Bearce, cochief of the Bureau's Division of Weights and Measures, the objections to a proposed perpetual calendar in which the years are of unequal length are pointed out. Such a plan violates one of the principal requirements of a satisfactory perpetual calendar, namely, that all calendar years be of the same length.

Another plan, known as the World Calendar, requires the interruption of the regular succession of the 7 days of the week by the insertion of a 24-hour period without weekday name at one point in each ordinary year, and at two points in each leap year. However, this is no more open to objection from the religious standpoint than is the recognized practice of dropping a day or repeating a day when crossing the international date line. The great advantage of the World Calendar plan is that it provides for a perpetual calendar with 12 months arranged in equal quarters. The complete paper on this subject has been submitted for publication in the Journal of Calendar Reform.

ERRORS IN AUGUST BULLETIN

On the first page of the August Technical News Bulletin the number of the Bulletin was given as "26." It should have been "268." In the table of contents, near the end, "Simplified Practice Recommendation" should be deleted. On the same page, second column, fifth line from bottom, the word "Part" should be "Parts." The heading of the item near the middle of the first column on page 85 should be "Thermal Insulation for Aircraft" instead of "Thermal Expansion for Aircraft."

NEW AND REVISED PUBLICATIONS ISSUED DURING AUGUST 1939

Journal of Research [2]

Journal of Research of the National Bureau of Standards, volume 23, number 2, August 1939 (RP1228 to RP1236, inclusive). Price 30 cents. Annual subscription, 12 issues, $3.50.

Research Papers [2]

[Reprints from June 1939 Journal of Research]

RP1209. Standardization of the luminous-transmission scale used in the specification of railroad signal glasses. Kasson S. Gibson and Geraldine Walker Haupt. Price 5 cents.

RP1210. Development of a fibrous texture in cold-worked rods of copper. Herbert C. Vacher. Price 10 cents.

RP1211. Effects of methionine, djenkolic acid, and benzylcysteine on the estimation of cystine by the dropping mercury cathode. Edgar Reynolds Smith and Clement James Rodden. Price 5 cents.

RP1212. Nature of energy losses in air capacitors at low frequencies. Allen V. Astin. Price 5 cents.

RP1213. Electroanalytical determination of copper and lead in nitric acid solution containing small amounts of hydrochloric acid. John A. Scherrer, Rosemond K. Bell, and William D. Mogerman. Price 5 cents.

RP1214. Bubbler tip of pyrex glass for difficult absorptions. Joseph R. Branham and Edward O. Sperling. Price 5 cents.

RP1215. Effects of aluminum and of antimony on certain properties of cast red brass. Harold B. Gardner and Charles M. Saeger, Jr. Price 10 cents.

RP1216. Resolving power and distortion of typical airplane-camera lenses. Francis E. Washer. Price 5 cents.

RP1217. Edge correction in the determination of dielectric constant. Arnold H. Scott and Harvey L. Curtis. Price 5 cents.

Technical News Bulletin [2]

Technical News Bulletin 268, August 1939. Price 5 cents. Annual subscription, 50 cents.

[2] Send orders for publications under this heading only to the Superintendent of Documents, Government Printing Office, Washington, D. C. Subscription to Technical News Bulletin, 50 cents per year; Journal of Research $3.50 per year (United States and its possessions, and Canada, Colombia, Cuba, Dominican Republic, Ecuador, Guatemala, Honduras, Mexico, Newfoundland (including Labrador), Panama, and Venezuela); other countries, 70 cents and $4.50, respectively.

MIMEOGRAPHED MATERIAL

Letter Circulars

[Letter Circulars are prepared to answer specific inquiries addressed to the National Bureau of Standards and are sent only on request to persons having definite need for the information. The Bureau cannot undertake to supply lists or complete sets of Letter Circulars or send copies automatically as issued.]

LC561. List of Simplified Practice Recommendations, revised to July 1, 1939. (Supersedes LC345.)

RECENT BUREAU ARTICLES APPEARING IN OUTSIDE PUBLICATIONS [3]

Some contributions of radio to other services. J. H. Dellinger. J. Franklin Inst. (Philadelphia, Pa.) **228**, 11 (July 1939).

An investigation of a supposedly nontarnishing amalgam. G. C. Paffenbarger. J. Am. Dental Assn. (212 East Superior St., Chicago, Ill.) **26**, 990 (June 1939).

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